COMMUNICATION

What is Communication and how is it related to Business Knowledge and Processes?

Communication is how we give and receive information and convey our ideas and opinions. To communicate effectively, technicians need to develop verbal, written, and visual communication skills and active listening skills. They also need to be aware of the meaning conveyed by non-verbal communication cues. It is important to differentiate informal communication, which may be part of a one's social connections in the workplace, from formal communication. Formal communication requires consideration of the audience, the purpose, and attention to tone. This can help prevent miscommunication.

Vocabulary

- **Verbal** – communication through spoken sounds, word choice, tone of voice
- **Non-verbal** – communication through facial expressions, body language, posture, position in the room, movement
- **Active listening** – process of paying careful attention while hearing information and focusing on all of the content before responding
- **Written** – information conveyed through emails, reports, text messages and other written media
- **Visual** – information presented through signs, symbols, and graphic representations
- **Tone** – manner of expression in speaking or writing when used to express an emotion
- **Informal** – unofficial and spontaneous communication between leaders, colleagues, and others in the workplace
- **Formal** – the official interchange of information between leaders, colleagues, and others in the workplace
- **Miscommunication** – failure to communicate adequately

How will technicians use communication?

In her job as a manufacturing technician, Kate is part of wafer production team creating the very latest semiconductor chips to power PCs, tablets, smartphones, and wearable devices. To ensure a smooth transition between shifts, Kate verbally shares with the incoming technician a summary of what happened during her shift. There is a brief shift overlap which gives Kate plenty of time to talk about the typical daily production items. If there are any major problems that come up, however, Kate will need to provide documentation by writing a description of the problem, the root cause (if known), and whether it was resolved. She can do this through an email to her supervisor and the technician coming on board for the next shift. Kate includes a subject line stating the email is about a problem during her shift. She starts her emails with a formal salutation, using her colleague and supervisor's names. The body of the email is concise and to the point. Kate reviews her emails carefully before sending it out to ensure that it is free of errors and that she has used a professional tone.





COMMUNICATION

Skills Needed for a High-Paying Career

- Communicating verbally (phone calls, personal communication, professional conversations, presentations, interviews)
- Listens actively, asks clarifying questions, and summarizes information to check for understanding
- Comprehends written material
- Conveys information professionally in writing (reports, memos, emails, faxes, forms, letters)
- Responds carefully to nonverbal communication
- Selects the appropriate media for presentations (presentation slides, photos, graphics, drawings, video, audio recordings)
- Combines written, verbal, and media communication effectively (data visualization, training, team troubleshooting

Education

Your local community college provides the classes you will need. Skills for speaking and writing well are most often taught within courses as part of presentation skills but may be offered within courses required for the general education component of the associate degree or one-year certification or within workforce preparation coursework. Communication skills are critically important across all technical fields, including agricultural, cybersecurity, biomedical, energy, environmental, engineering technologies, etc. Community college course schedules are designed to accommodate the needs of working students and often include online and hybrid delivery formats. Find your nearest community college here.

Future Trends

The future will include using communications skills in:

- Remote and hybrid work environments
- Meetings with higher definition video conferencing
- Artificial Intelligence, Augmented Reality, and Virtual and Augmented Reality collaboration platforms
- Wearable Apps
- A global economy requiring intercultural communication skills

Learn More

- Communication Skills at Work: 4 Key Tips (video)
- How to Communicate Better with Coworkers

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COMMUNICATION

What Is Communication?

Communication is the transfer of information to produce greater understanding. It can be done verbally (through words, vocal tone and pitch), nonverbally (through body language and gestures), visually (using graphs, charts, or maps), and through writing.

Communication Competencies

- Communicating verbally (phone calls, personal communication, professional conversations, presentations, interviews)
- Listens actively, asks clarifying questions, and summarizes information to check for understanding
- Comprehends written material
- Conveys information professionally in writing (reports, memos, emails, faxes, forms, letters)
- Responds carefully to nonverbal communication
- Selects the appropriate media for presentations (slides, photos, graphics, video, audio recordings)
- Combines written, verbal, and media communication effectively (data visualization, training, team troubleshooting)

Cross-disciplinary Skills

- Selecting the appropriate methods to communicate with diverse audiences
- Using visualization tools effectively to present data
- Proficiency with digital communication technologies
- Following ethical principles in the digital world

Information Security Scenario

Jayden is a Network Technician for an engineering consulting firm. Recently, the company had a cyber incident. One of the employees in the accounting department clicked on a link that she thought was from the IRS, but it wasn't. When she clicked on the link, she was asked to enter the company's login information, which gave cyber criminals access to their company's financial details. To prevent this type of incident from happening again, Jayden needed to communicate to all employees in a clear, concise manner about the danger of clicking on unsolicited email links and attachments and how to stay alert for warning signs of fraudulent emails. He did this by creating a one-page document with bullets that stated what not to do and why and the importance of contacting him if they receive suspicious emails. Jayden used 10 minutes of the company's weekly staff meeting to present the document and then followed up with an email and attached the document so everyone at the company would have access to both hard and electronic copies.

Energy Technology Scenario

Ray recently began a position as a Nuclear Operations Technician soon after graduating with an associate degree from a nearby community college. Ray works in the control room for a nuclear power plant and is spending the next year training with a more experienced technician. Gaining the technical knowledge from college has provided an essential foundation to his work but asking key questions now that he's on the job has been equally important. Ray carries an iPad with him to take notes and to document questions and answers throughout the day. After asking a question, he types notes on what he hears and sends the summaries back to his supervisor for verification. If what he heard demonstrates misunderstandings, Ray corrects his notes, then summarizes again to make sure he is on target. This is a practice he uses when he meets with engineers and scientists at the plant as well. Not only does it help Ray, but others at the company have shared that it helps them build confidence in Ray's abilities as a new technician.

COMMUNICATION

Activity

This activity asks students to explore how technicians use process writing. First, students to watch a video of a process. They create a written set of processes on their own then consolidate and finalize the process document with a partner.

Warm-Up

Review the types of communication. Explain that one type of communication technicians frequently use is written communication, such as emails, memos, lab reports or technical procedures for using equipment. Each of these types of writing requires a distinctive style based on purpose and audience. Discuss that procedural writing outlines process steps in the order they need to be completed. Well-written procedures are factual, precise, and provide the reader with adequate detail. It is important to write a draft or practice document before sharing it with others who will use the process. Ask students for examples of when they've used a procedural document such as a lab manual or Standard Operating Procedures (SOP) manual in the past and what made it effective or ineffective.

Activity Steps

1. Explain to students that the activity is for them to watch a procedure and translate it into written directions. Ask what procedural documents they might need to write in their fields.
2. Review or provide brief background on cobots. A cobot is collaborative robot typically used in advanced manufacturing. The activity will have students first learn how to program a cobot through watching a video and then write the procedure for programming a cobot.
3. Have students watch The Cobot: A Tutorial video all the way through.
4. Students watch the video again through 3:40, documenting the steps they are watching. They can stop the video and/or watch a few more times to write down all the process steps.
5. In pairs, students compare their steps. Together they should revise the procedure to ensure the documentation is clear, concise, free of errors, and could be submitted as a formal process write-up in the workplace.
6. Have pairs share their procedure steps with the class.
7. Questions to pose to close out the activity: (a) What were the similarities and differences in the procedure documents you and your partner created separately? (b) What are challenges or opportunities for doing this type of writing in your field of study?

Read More

- 12 Tips to Effective Communication in the Workplace
- Working Stronger and Smarter: A Handbook on Theory and Techniques for Developing Employability Skills for Technicians
- "Communication," from the Employability Skills Resource Toolkit

ABOUT THE PROJECT

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ENTREPRENEURSHIP

What Is Entrepreneurship?

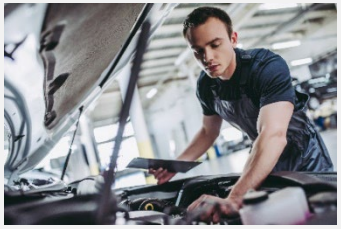
Entrepreneurship is the concept of developing and overseeing a new business for profit. Working inside a company and thinking like an entrepreneur by asking "how can we improve this process?" is just as important. Entrepreneurship means thinking beyond troubleshooting or problem solving. It involves taking extra effort that yields potential new products, services, or processes.

Vocabulary

- **Entrepreneur**—An individual who starts a new business venture. Typically, the individual who takes on most of the risk and develops the business concept.
- **Venture**—A business enterprise in which the expectation of gain is accompanied by the risk of loss or failure.
- **Capital**—The wealth or assets available to invest in a business.
- **Business Model**—A description of how a business will be able to create and deliver value and become profitable.
- **Market Research**—Relevant data that helps demonstrate market potential for a business venture.
- **Intellectual Property**—Works or inventions that is the result of creativity to which one has rights and can apply for a patent, copyright, or trademark.

How will an entrepreneurial mindset be used in the workplace?

An Industry 4.0 technician of tomorrow needs creative entrepreneurial thinking as a new, expected skill. John Gruene is an automotive technician at Advanced Auto. Lately John and his team have experienced several customer complaints regarding repair times. Using an entrepreneurial mindset, John identified the problem and then researched possible solutions and their value propositions. He asked questions like: how much is customer satisfaction and loyalty worth? and how much time and money can be saved through more accurate diagnosis and efficient repair? He then approached his supervisor about a potential solution he has researched that will provide better customer service, shorter wait times, and fewer errors by the technicians, resulting in higher profits for the business.



In another example, Casey Sanders is a robotics technician at Cooper BioLogic, an automated filling and packaging company. Over the last seven days, a robot gripper has been dropping every hundredth vial. The fault affected everything down the line, to the point at which several boxes shipped to a customer were short a few vials. This is clearly not an acceptable business practice. Casey applied troubleshooting skills to determine which gripper was malfunctioning and replaced it. But next Casey went further and used an entrepreneurial mindset in thinking about the whole line. She calculated the current time from production to packaging and suggested that new technologies, such as soft grips, could be integrated into the process to increase efficiency and accuracy and decrease product time-to-customer.





ENTREPRENEURSHIP

Skills Needed for High-Paying Jobs Using an Entrepreneurial Mindset

- Thinking creatively, like an entrepreneur
- Researching (e.g. current products and markets)
- Networking strategically
- Solving problems and thinking critically
- Communicating clearly with all stakeholders
- Planning carefully and effectively
- Calculating finances accurately

Education

Your local community college provides the classes you will need. Skills for researching, planning, and starting a business based on an entrepreneurial idea are most often taught within a Business program but may also be included in an Engineering Technology or other technology program offering associate degrees and one-year certificates. Entrepreneurship skills are also important in other technical fields in which you might start a company, invent a machine or process, or provide services. Community college course schedules are designed to accommodate the needs of working students and often include online and hybrid delivery formats. Find your nearest community college here.

Future Trends

- Design Thinking—Processes for designing products, buildings, and machines and for solving problems known and unknown
- Agility—The ability to shift priorities quickly
- Disruption—The effect on the market when when a new product "explodes" in popularity
- Mobile commerce—Buying electronically via website or app
- Home-based businesses—Online shopping, remote work, and the popularity of social media have made home based businesses thrive
- Niche markets—Customer focused businesses that can be tailored to defined markets of unique groups

Learn More

- Understand the Basics of Creating and Financing a Successful Business
- How to Write a Business Plan (video)
- Learning about the Entrepreneurial Mindset

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ENTREPRENEURSHIP

What Is Entrepreneurship?

Entrepreneurship is the process of starting a business or other organization. The entrepreneur develops a business model, acquires the human and other required resources, and is fully responsible for its success or failure. Entrepreneurship operates within an entrepreneurship ecosystem.

Entrepreneurship Competencies for Technicians

- Demonstrating consistent leadership
- Making decisions independently
- Staying focused and maintaining inner drive
- Computing company financial data -- costs and other business expenses; profit/loss, taxes, projected income, budgets, etc.
- Understanding marketing principles

Cross-disciplinary Skills

- Creating and interpreting spreadsheets
- Visualizing data
- Solving problems and improving processes through innovative solutions
- Understanding business cycles and supply/demand
- Demonstrating ethical behavior
- Managing time efficiently
- Communicating clearly, concisely, and persuasively to a variety of audiences, i.e. teams, management, clients, and suppliers

Manufacturing Scenario

Jane works as a technician at US Manufacturing. US manufactures customized components for the auto sector. The industry is extremely competitive, and US is looking for ideas on how to increase optimization, efficiencies, and develop new products. Jane approaches her supervisor about a concept she has thought about that would reduce their error rates on the production line. The process involves removing one step in the process and changing the flow of the hand-off of the product. She has researched the process, demonstrated that it can take 15 seconds off the time, and would like to see if the final step can assist the finishing team. Jane worked with management to help define how this could provide value to US and its customers.

IT Scenario

Jim works for LMN Cabling in the field as an installer. Daily he is bombarded with customer complaints regarding other technicians. He notices a trend that most of the complaints are regarding a challenge with a switch and how to use it. When he is approached by customers, he takes the time to review the process and makes sure they have a good understanding on how to use it. Jim takes the initiative to go to his manager and suggest developing a user card for all the installers to walk through with the customer following the install. Management supports the idea and has Jim train the team on using the card and including it as a final check of the completed installation.

ENTREPRENEURSHIP

Activity

The activity will place students in groups of 3-4 and assign them each a product, process, or service from their primary field of study. The students will be given instructions that the product is brand new to the market with preliminary market research on it. Students need to work collaboratively on creating a business plan.

Warm-Up

Introduce or review the components of a business plan. Show the 3-minute video, "How to Write a Business Plan" – a clear and concise overview of the elements needed. Entrepreneurs need to develop a business plan that ultimately serves as their guide with goals and objectives for their business. The process of developing a business plan includes identifying the problem the business solves, the market it serves, required resources, and financial planning and modeling. A thorough business plan will include in-depth market analysis, and financial projections to demonstrate the viability of the business concept.

Activity Steps

1. Students will be in groups of 3-4 and each group should determine a product, process, or service they wish to sell. (5 min)
2. Student teams will answer some essential questions about their business. (20 min)
   a. What products or services will our business provide?
   b. Who is our competition?
   c. Who needs or wants this product, process, or service?
   d. How large an investment will be needed to launch this start-up?
   e. How soon can our business start providing the product, process, or service?
   f. How many employees will we need at first?
   g. Who can we ask for advice about this venture?
3. Students will report out on their new business idea and share how they approached planning. (5 min)

The whole group responds to each business idea. Will they predict success or failure? Why? (10 min)

Tools for Creating a Business Plan

- A well-organized blank Business Plan creation template with very good instructions and explanations can be downloaded free from the SCORE site.
- Another tool is the Business Model Canvas. Read The Business Model Canvas Explained and then download the blank template.

Read More

Students may have questions about patents and intellectual property rights. They can learn more from the Small Business Encyclopedia. Additional ideas for teaching about entrepreneurship can be found in the NC-NET Employability Toolkit, Module 8.

ABOUT THE PROJECT

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LEAN PROCESSES

What are Lean processes and how are they related to Business Knowledge & Processes?

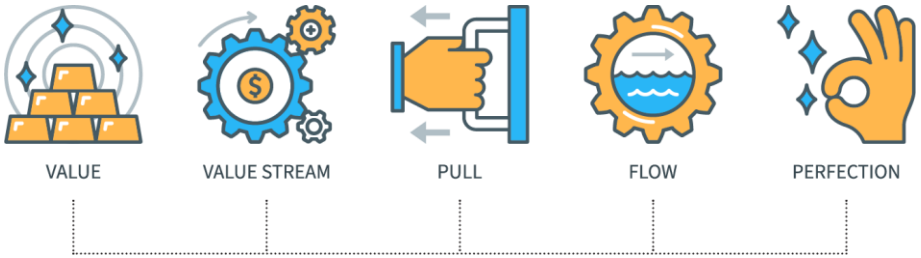
Lean processes focus on maximizing customer value while using fewer resources and minimizing waste. Lean thinking means always thinking about how processes and products can be improved.

Vocabulary

- **Continuous process improvement**—the ongoing improvements of products, services, or processes; related to the Japanese term **Kaizen**—improvement; good change
- **Efficiency**—the ability to achieve a goal with the least amount of waste
- **Waste** – materials or processes that are not creating value for the customer
- **Value** – what the customer is willing to pay for goods they want
- **Value stream** – all the steps in a work process that end with something a customer wants
- **Pull** – producing and delivering products and services when there is customer demand for them; related to the Toyota Kanban method
- **Flow** –ensuring steps in the value stream run smoothly without interruptions, delays, or bottlenecks
- **Perfection** – the overarching goal of meeting customer needs and striving to do it better each day (source)

How will technicians use Lean processes?

Amelia is a manufacturing technician for an automotive parts company. She has been recognized for her contributions to the company's delivery of quality parts on time to their customers. Recently, Amelia was becoming frustrated that her workstation was being left in disarray from the previous shift. This was impacting her daily production goals. She discussed this with her supervisor and found out there were other issues affecting productivity across shifts. Her supervisor facilitated a meeting with all the technicians to identify the root cause of the problems. Together they came up with a plan to address the decreased productivity. The last 10 minutes of a shift would overlap with the first 10 minutes of the next shift. Processes would not stop running—the flow (a critical principle of Lean manufacturing) would continue—but the technicians would have time to communicate important information, clean the work area, and check machinery (if needed). This change increased the company's manufacturing productivity and resulted in higher job satisfaction for Amelia and the other technicians.







LEAN PROCESSES

Skills Needed for a High-Paying Career

- Prioritizing what customers value
- Following company business processes
- Staying current with technological advancements
- Thinking creatively about how to solve problems
- Communicating effectively
- Demonstrating teamwork

Education

Your local community college provides the classes you will need. An understanding of Lean processes is most often taught within an Engineering Technologies, Advanced Manufacturing or Business associate degree program or in Management courses within general education requirements of an associate degree. Lean business processes affect all sectors of the economy, including businesses and industry in technical fields in which you might work or start your own company. Community college course schedules are designed to accommodate the needs of working students and often include online and hybrid delivery formats. Find your nearest community college here.

Future Trends

The future of Lean business processes includes:

- More small businesses adopting Lean processes
- Combining Lean business processes with advanced digital technologies like the Internet of Things
- Integration of big data
- Data-driven decision making
- Emphasis on problem solving, interpersonal skills and teamwork

Learn More

- What Is Lean Process Improvement?
- The Five Principles of Lean
- Why Use Kanban to Establish Pull Systems?

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LEAN PROCESSES

What are Lean Processes?

Lean processes are design to help businesses identify and eliminate waste, focus on the activities that create value for the customer, and ultimately, increase company profitability. The approach is based on the idea of continuous improvement and involves ongoing process adjustments to achieve better quality and flow, less time and effort, and lower cost.

Lean Processes Competencies

- Analyzing data to ascertain what customers value
- Following company business processes
- Staying current with technological advancements
- Thinking creatively about how to solve problems
- Communicating effectively
- Demonstrating teamwork

Cross-disciplinary Skills

- Selecting and utilizing appropriate analytics tools
- Conducting stakeholder analyses
- Instituting continuous process improvement
- Calculating Overall Equipment Efficiency (OEE)
- Communicating with internal and external stakeholders

Supply Chain and Logistics Scenario

Ezra is a Logistics Technician for a food supply chain company that provides warehousing and transportation services to restaurants, schools, and retail companies. Ezra is responsible for continuous process improvements in the warehouse. Ezra learned about an automation software program that would be a breakthrough improvement in helping the company better track their inventory without having to rework other processes or the layout of the warehouse. Radio Frequency Identification Data (RFID)-enabled plastic pallets would replace the company's current pallets. These special pallets have RFID tags inserted. RFID provides real-time visibility and location data specific to warehouse aisles, shelves, and shelf level locations. RFID would allow Ezra to track not just pallets and boxes, but the contents inside the boxes as well. RFID are a wireless technology, so Ezra does not need to do any scanning, making this an automated process. Ezra's company has been using the new pallets for one month and is already realizing more efficient inventory management and less waste.

Information Technology Scenario

Mariana is a Network Technician for a small construction company that is part of a network of local companies committed to Lean construction. The company was continuously seeking business process improvements to ensure customers receive the highest quality services at the best rates. Mariana knew her company would benefit from a new server given theirs was nearly five years old. Mariana researched the Environmental Protection Agency's (EPA) enterprise server efficiency levels product information on the Energy Star web site to inform their purchase of a new server. The Energy Star servers included must be priced no more than $118 than a less efficient model. An efficient product is cost-effective when the lifetime energy savings (from avoided energy costs over the life of the product, discounted to present value) exceed the additional up-front cost (if any) compared to a less efficient option. Servers have become higher performance and more efficient the past 3-4 years; therefore, the company could expect the savings to be even greater.

LEAN PROCESSES

Activity

This activity provides students the opportunity to explore Lean business processes and how they can be used in technician roles. Begin with the video and guiding questions in the warm-up. Next, have students review the infographic about Lean principles. Then, break students into groups to discuss the assigned technique and prepare for a brief presentation.

Warm-Up

Review the definition of Lean and examples from the scenarios. Have students watch these 2-minute videos: Five Lean Principles and Why Do Lean Manufacturing?

Ask students:

- What did you learn from the video?
- What examples of "Lean thinking" have you demonstrated personally, at school or at work?

Activity Steps

1. Begin by reviewing the definition of Lean and examples from the scenarios.
2. Have the students watch the video, then pose the questions in the warm-up to them.
3. Next, project the infographic, Five Lean Principles for Engineers, for students to review.
4. Break students into groups of 3-4 students. Assign each group a lean principle.
5. Have students discuss their Lean principle and how it could be applied to the work of technicians in their discipline or career of interest.
6. Have groups do a brief presentation to the class about application of their principle.

Tools Available

- The Plan-Do-Check-Act (PDCA) Cycle outlines four steps for managing continuous business assessment and process improvement. Continuous process improvement is a key feature of Lean practices. This free checklist walks you through the process.

Read More

- Lean Process Improvement: Achieving Project Success with Process Optimization
- Lessons in Lean Management for Any Industry

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SUPPLY AND DEMAND

What is supply and demand and how is it related to Business Knowledge & Processes?

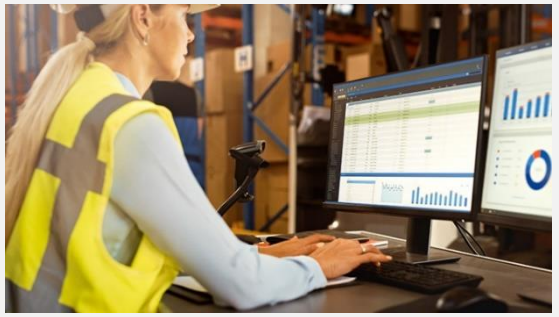
Supply and demand is the relationship between the amount of goods and services, or labor available and the amount customers want. Understanding supply and demand provides technicians insight into many of the business decisions of their employers, such as what products and services they offer, how much they charge, how the products and services are marketed, and potential plans to expand. The concept of supply and demand even impacts the number of technicians companies hire, salaries, and available career paths in a company.

Vocabulary

- **Demand** – The ability and willingness to buy a product.
- **Law of Demand** – If prices go up, demand goes down. If prices go down, demand goes up.
- **Supply** – The total amount of a good or service that is available to consumers.
- **Law of Supply** – An increase in price results in an increase in quantity. A decrease in price results in a decrease of quantity.
- **Supply Curve** – Demonstrates the supply of a product or service that would be available at different prices.
- **Economics** – The study of the production, distribution, and consumption of goods and services.
- **Market** – All of the buyers and sellers of a particular product or service within a region.

How will technicians use skills and knowledge related to Supply and Demand?

Maria is a Solar Technician in Florida. She had been very busy connecting new residential solar photovoltaic installations until recently and was wondering why fewer customers were choosing solar energy. She did some research and found out that the production costs of solar panels have risen over the past several months due to the jump in prices for two of the essential raw materials, aluminum and steel. In response, the manufacturer raised its prices on the panels it sold to the solar installation company. Maria's company needed to pass on the cost to customers, so the cost of solar panels increased. Fewer potential customers were willing to buy the panels at the higher price. Maria's analysis explained how the reduced supply of the materials impacted prices, and therefore, lowered the demand for residential solar energy.







SUPPLY AND DEMAND

Skills Needed for a High-Paying Career

- Analyzing data to forecast demand
- Interpreting financial spreadsheets
- Determining how current events will impact the market
- Identifying supply and demand, business cycles, and market trends
- Explaining processes impacted by supply and demand to a variety of stakeholders

Education

Your local community college provides the classes you will need. An understanding of supply and demand is most often taught within a Business program but may also be included in an Engineering Technology or other technology program offering associate degrees and one-year certificates. Supply and demand may also affect other technical fields in which you might start a company, invent a machine or process, or provide services. Community college course schedules are designed to accommodate the needs of working students and often include online and hybrid delivery formats. Find your nearest community college here.

Future Trends

Supply and demand in the future will be impacted by:

- Direct sales to consumers which reduces costs and increases customer feedback
- Government policies that influence international trade altering supply and demand and consumer spending
- Challenges in finding talent, impacting expansion plans, and increasing automation and hiring outside of the U.S.

Learn More

- Difference Between Supply + Demand
- Economic Lowdown Podcast Series
- Infographic of Supply and Demand

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SUPPLY AND DEMAND

What Is Supply and Demand?

According to the Federal Reserve Bank, supply is the interaction between the quantity of a good or service that producers are willing and able to sell at all possible prices during a certain time period and demand is the quantity of a good or service that buyers are willing and able to buy at all possible prices during a certain time period. Supply and demand also apply to the labor market. It refers to the number of job openings and the number of individuals looking for work.

Supply and Demand Competencies

- Analyzing data to forecast demand
- Interpreting financial spreadsheets
- Determining how current events will impact the market
- Identifying supply and demand, business cycles, and market trends
- Explaining processes impacted by supply and demand to a variety of stakeholders

Cross-disciplinary Skills

- Creating and interpreting spreadsheets
- Using computational thinking strategies
- Interpreting statistics accurately
- Comprehending business practices
- Solving problems and improving processes
- Performing customer/stakeholder analysis

Automotive Scenario

When the tiny, two-seat Smart Cars first arrived in the U.S. in 2008, it was a time when gas prices were very high and consumers were looking at energy efficient alternatives in the car market. Dwayne, an Automotive Technician, began servicing these cars at his Mercedes-Benz dealer in early 2009. Since then, sales and service of Smart Cars have been dropping to the point where Smart Cars stopped being sold in the U.S. in 2019. Given the drop in demand, Dwayne now only works on 1-2 per Smart Cars per month. To ensure he has job security, Dwayne is taking Hybrid Electric Vehicle Technology courses at his local community college.

Agriculture Scenario

Sharon is an Agricultural Technician who serves several large farms in her town. She met with her clients recently to share how using global positioning systems (GPS) surveying can save them money by providing more accurate measurements of their field acreage. This is important since fertilizers applied via aerial applicators are charged on a per acre basis. Their current measurements are based on government estimates using aerial photographs, which are not precise. Sharon has a vendor that uses the latest GPS technology and has discovered that most of his other customers' fields are typically 5-10% fewer acres than they thought. That has meant 5-10% savings for the farms since they purchased less fertilizer. All of Sharon's clients decided to go with the GPS surveying, increasing the demand for this service in her area.

SUPPLY AND DEMAND

Activity

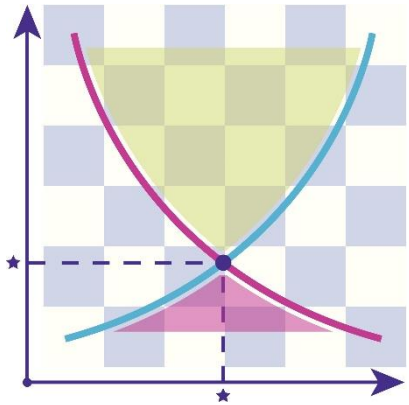
This activity focuses on the impact of supply of and demand for technicians. It provides the opportunity for students to explore a situation that is relevant to their future career paths. Begin with reviewing the definitions of supply and demand. Students will explore technician job projections on the U.S. Bureau of Labor Statistics Occupational Outlook Handbook online. They will discuss how their career path is impacted by supply of and demand for workers in their field.

Warm-Up

Show the 5-minute video The Labor Market, Economic Lowdown Series. Review the definitions of supply and demand and how they apply to the labor market. Provide the example of the nursing shortage and that U.S. hospitals are having difficulty finding nurses to fill the shifts. Hospitals are offering signing bonuses, flexible work schedules, and other benefits to entice nurses to choose them over other employers. This is also true for many technician positions. For automotive technicians, manufacturing technicians, and others, companies have increased their salaries and are offering additional benefits. In some cases, companies are signing employment contracts with students who are still in college and paying their tuition.

Activity Steps

- Students break up in groups of 3-5 to discover to discuss how supply and demand impacts their career paths.
- Students use the U.S. Bureau of Labor Statistics Occupational Outlook Handbook to locate the demand projections for their targeted occupation(s).
- Students find their occupation(s) and review the Number of Jobs, Job Outlook and Employment Change.
- Students discuss their findings in their groups.
- Students share what they discovered and how supply and demand impacts the world of technician careers as a class.



Read More

- Law of Supply and Demand
- Understanding the Labor Market

CORD Leading Change in Education

Preparing Technicians for the FUTURE OF WORK

NSF

ABOUT THE PROJECT

Preparing Technicians for the Future of Work, funded by the National Science Foundation Advanced Technological Education program, recognizes that technicians need an expanded skill set to remain competitive. The project's Framework for a Cross-Disciplinary STEM Core outlines recommendations for incorporating knowledge and skills in Advanced Digital Literacy, Data Knowledge and Analysis, and Business Knowledge and Processes. Learn more about implementing the Framework at preparingtechnicians.org.

ETHICS

What is Ethics and how is it related to Business Knowledge and Processes

Ethics refers to standards of right and wrong for human behavior. In technology, ethics issues arise regarding copyrights, privacy, freedom, data protection, online behavior, and more. Ethics apply to both individual employees and businesses. Technicians encounter dilemmas that require them to make ethical decisions addressing coworkers, supervisors, and leadership. Companies have a variety of policies and procedures in place for compliance purposes, but with the pace of technological advances, laws and regulations may still be in development. (The use of AI is a good example.)

Vocabulary

- **Code of Ethics** – a set of principles adopted by businesses or individuals outlining the difference between "right" and "wrong" to be applied in decision making
- **Compliance** – following rules a company and its employees must follow because of laws and regulations
- **Conflict of Interest** – an ethical dilemma arising when a person's self-interest is not in the best interest of another person or organization
- **Ethical Dilemma** – a complex situation that requires a business and/or individual to choose between two or more conflicting actions

How will technicians use Ethics?

June is a newly hired Laboratory Data Technician for a company that designs and manufactures sustainable packaging components for shipping food and pharmaceutical products. After reviewing the company's Code of Ethics and asking questions during the job interview, June decided the company shares similar environmental sustainability practices. She will be aggregating, analyzing, and reporting findings from the lab's testing data of materials. This will assist the company's thermal and packaging engineers in solutions development to match products to customer needs. Before starting work, June signed confidentiality agreements to protect specified company practices, policies, data, and information. This is a legally binding contract promising not to disclose trade secrets. Several months later, the company invented a new sustainable packaging material that could be a game changer for the industry. While she wanted to share the news with her best friend, another environmental enthusiast, June remembered that this was a trade secret under the confidentiality agreement and did not reveal the information.





ETHICS

Skills Needed for a High-Paying Career

- Displaying a commitment to workplace ethics
- Exhibiting ethical behavior in decision making and practices as applied to problems, issues, and dilemmas
- Following confidentiality expected for ethical use of information and programs
- Using technology in an ethical manner that respects the rights of employees, customers, and the company

Education

Your local community college provides the classes you will need. An understanding of ethics is most often taught within a Business associate degree program or in Management courses within general education requirements of an associate degree. Ethics skills are critically important across all technical fields, including agricultural, cybersecurity, biomedical, energy, environmental, engineering technologies, etc. Community college course schedules are designed to accommodate the needs of working students and often include online and hybrid delivery formats.

Find your nearest community college here.

Future Trends

Industry 4.0 embedded technology generates future trends in ethics related to the following:

- Automation and robots have ethical dilemmas in the design and use of these technologies. “Roboethics” is focused on the ethical implications of robotics technology.
- Artificial Intelligence (AI) and Machine Learning software allows computers to imitate humans reasoning, learning, and problem-solving skills. Ethics dilemmas are based on privacy, surveillance, bias, discrimination, and intellectual property ownership issues.
- Data management dilemmas focus on how data is handled, processed, and stored. Ethical problems often arise around the privacy of that data.
- Data analytics deals with data organization used to explain the past and predict the future.

Learn More

- Ethics: An Old Fashioned Soft Skill for the Modern World
- Professional Code of Ethics: Definition and Examples

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ETHICS

What is Ethics

Ethics refers to well-founded standards of right and wrong for human interactions with society at national, group, and individual levels. Moral and legal guidelines usually coincide with Ethics Principles. However, ethical behavior expectations are independent of those guidelines. In business, ethics is focused on what individuals or companies ought to do, usually in terms of rights, obligations, benefits to society, fairness, and honorable civic behavior.

Ethics Competencies

- Displaying a commitment to workplace values and ethics
- Creating a personal code of ethics to apply to a professional code of ethics
- Exhibiting ethical behavior in decision making and practices as applied to dilemmas, issues, and problems
- Demonstrating ethical use of information and programs, and respect for confidentiality
- Using technology in an ethical manner that respects the rights of employees, customers, and the company

Cross-disciplinary Skills

- Providing accurate data for analysis
- Managing the privacy of data
- Maintaining security controls
- Conducting stakeholder analyses
- Managing risks that could impact the company and its customers
- Communicating effectively with internal and external stakeholders

Cybersecurity Scenario

Paul is a technician for a biotech company that does gene sequencing. The company deals with highly personal health information, so security of their computer system is a top priority. One of Paul's responsibilities is to perform scheduled security updates on all the employees' computers. Everyone in the company knows in advance when their update will take place. Paul tried to update the vice president's computer but was asked to do it another day. Unfortunately, Paul did not have wiggle room in his schedule. The vice president then asked him to skip the update. This created an ethical dilemma for Paul since not doing the update potentially causes a security lapse, but he felt pressure to abide by his superior's wishes. Paul asked again to complete the update and explained why this was essential to protecting patients' health information. Luckily, the vice president agreed to the computer security update.

Nuclear Energy Scenario

Alejandro is one of several Radiation Protection Technicians responsible for calculating radiation levels at a nuclear power plant. The next-shift technician is expected to come to work 30 minutes prior to the end of the previous shift to be briefed, but for the past two weeks he has been late for work. This has given Alejandro insufficient time to provide the required details. It has also created an ethical issue since their supervisor did not know about this new late arrival habit. Alejandro discussed his concerns with the next-shift technician, but there was no change in work arrival time. He did not want to be viewed as a non-team player but still scheduled a meeting with his supervisor to share what was happening, with a focus on how it impacts his own performance. After supervisor intervention, the expected schedule was resumed, the next-shift technician apologized, and the ethics issue was resolved.

ETHICS

Activity

This activity is designed to provide students the opportunity to consider ethical dilemmas they might encounter as technicians. They will be presented with one such scenario and discuss how they would handle it. Then, they will form small groups to develop realistic and challenging scenarios involving an ethical decision they might encounter as a technician, for another team in the class to discuss and solve.

Warm-Up

Review the definition and basic terms for ethics. Have students share ethical principles they adhere to in their personal and/or professional lives. Next, read the workplace scenario to students:

> *You are a manufacturing technician who has discovered an error made by your department which may result in rejects and rework at a later point. The error is small, but you cannot determine what the effects on the final product might be. If you report the error, your department will look bad, and you might even lose part of your profit-sharing for the quarter.*

Have students identify the ethics principles that apply to the situation and make recommendations for how it should be handled. Note: There are no right or wrong answers but there may be correct and incorrect approaches to resolving the situation. The scenario is intended to cause students to think about their code of ethics and how those principles impact their decisions.

Activity Steps

1. Remind students about ethics roles in the workplace, and that technicians are part of that everyday world. Have students get into groups of 4 or 5. They should select a recorder or note-taker for the team. Their task is to design a scenario that is realistic, yet challenging, for other participants in the class to solve.
2. Have each team discuss possible scenarios then write the draft on a piece of paper with enough detail so another group can evaluate it. Include team members' names on the draft.
3. Each group then trades their scenario with another group and that group discusses how they would solve the scenario.
4. Finally, come back together and have each group read their scenario and explain how they decided to solve the ethical dilemma.

Tools Available

- Daniels Fund Ethics Initiative (free tools, curriculum, resources)
- Markulla Center for Applied Ethics (free curriculum, resources)

Read More

- What is ethics?
- Professional and Ethical Behavior in the Workplace
- Ethical Concerns Mount as AI Takes Bigger Decision-making Role in More Industries

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